Lightning Location, Classification, and Parameterization with the Los Alamos Sferic Array

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For two years, the Space and Atmospheric Science Group at Los Alamos National Laboratory has operated an array of electric field change meters to study lightning in support of radio-frequency and optical measurements made by the FORTE satellite. The array currently features 11 stations that operate continuously and provide 24 hour/day acquisition of triggered waveforms. Field change data from the array are used to locate, classify, and parameterize as many as 20,000 lightning discharges per day.

Lightning discharges are located in two dimensions (latitude and longitude) using the differential times of arrival of event waveforms from multiple stations. Some lightning waveforms (perhaps 5\%) feature distinguishable skywave 'reflections' that occur after the groundwave signals in individual field change recordings. For intracloud events that produce such 'reflections', we are able to estimate the height of the field change source. Three-dimensional locations for these intracloud events are determined automatically by LANL sferic array software. A class of events for which this technique works particularly well (owing to the isolation of the large-amplitude pulses on time scales of hundreds of microseconds) is compact intracloud discharges (CIDs).

Waveforms from multiple stations are used to classify and parameterize lightning discharges. Waveform characteristics that are used in the evaluation include polarity, rise-time, fall-time, and isolation. The event classification categories include negative and positive cloud-to-ground discharges, intracloud discharges, and narrow negative and positive bipolar pulses (NNBPs and NPBPs, which are associated with CIDs). Event parameterizations include peak current and dipole moment change.